DOCUMENT RESUME

ED 377 818 IR 016 914

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TITLE Regulatory Enhancements, Infrastructure Modernization, and Connecticut's Establishment of a Statewide, Interactive, Distance Learning Interconnection.
PUB DATE Sep 94
NOTE 19p.; Paper presented at the NARUC Biennial Regulatory Information Conference (9th, Columbus, OH, September 6-9, 1994).
PUB TYPE Reports - Evaluative/Feasibility (142) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Cable Television; *Distance Education; *Educational Technology; Elementary Secondary Education; Higher Education; *Information Networks; Interaction; Pilot Projects; Program Improvement; Rural Areas; State Legislation; State Programs; *State Regulation; Technological Advancement; *Telecommunications
IDENTIFIERS *Connecticut; Infrastructure

ABSTRACT

The Connecticut State Legislature has adopted sweeping telecommunications legislation that will enhance distance education in the state through cable television and telecommunications technologies. This legislation eradicates the delimitation on cable operators of one-way transmission of cable signals and removes the primary statutory restriction on two-way instructional programming broadcasts. Connecticut's educational telecommunications innovations are funded through sources that include grants from the Southern New England Telephone Company (SNET). SNET's electronic information network, I-SNET, is a network that will be constructed over 15 years to facilitate a mixture of entertainment options and business applications. Distance education will be a major beneficiary of network services. The state's evolving information infrastructure is enabling the state to narrow the educational gap between its rural and urban areas in elementary, secondary, and higher education. A pilot program, "Knowledge Plus," is being established as a testing ground for research and development in remote education. Background information on this program and other initiatives is outlined. Four tables present information about program development. (SLD)

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Regulatory Enhancements, Infrastructure Modernization, and Connecticut's Establishment of A Statewide, Interactive, Distance Learning Interconnection

Paper Presented at the Ninth NARUC Biennial Regulatory Information Conference
September 6-9, 1994
The Ohio State University
Columbus, Ohio

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The Connecticut State Legislature has adopted sweeping telecommunications legislation that will ultimately enhance distance education in the state. Public Act 94-83 requires the state's regulatory utility agency, the Department of Public Utility Control (DPUC) to begin unbundling or dismantling the monopolistic configuration of the existing local exchange network.[1] The legislation, entitled: *An Act Implementing the Recommendations of the Telecommunications Task Force* enhances remote educational opportunities in both the cable television and telecommunications technologies. The prior restrictions on two-way cable transmissions, previously reserved for local exchange companies has been expanded for educational programming purposes: "....(D) The two-way transmission of educational or instructional programming to a public or private elementary or secondary school, or a public or independent institution of higher education."[2] This legislation eradicates the delimitation on cable operators of one-way transmission of cable signals, and removes the primary statutory restriction on two-way instructional programming broadcasts.

Telecommunications Funding Programs

The state's primary telecommunications carrier, the Southern New England Telephone Company, (SNET) has supplied, since 1990, a Telecommunications Incentive Grant (TIG).[3] Initially authorized by the General Assembly in 1986 and implemented in 1988, SNET has supplied the TIG funding since 1990 with a $1.5 million grant.[4] The Company has been the primary mover with regard to the effectuation of educational telecommunications in the state. In addition to the TIG, SNET has also supplied the I-SNET Learning Leadership Grant. The Company made available grant monies to approximately 20 school districts throughout the state in 1994. Approximately 150 Connecticut schools have received TIG funding since 1988, with the average award being about $2,500. Uses that Connecticut schools have effectuated include: enhancement of urban to rural school communication, electronic pen pals, global awareness, and voice mail. Schools have also used the funding to install modems and concomitant software to allow students access to national educational databases.

ACES

Area Cooperative Educational Services (ACES) is a distance learning consortium begun in 1986 as a collaborative effort among the school districts of Amity, Cheshire, Hamden, and North Haven. The consortium's educational offerings have

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[1] MCI Telecommun cations Corporation Position Paper: Infrastructure Vision Docket. New Britain, CT: Department of Public Utility Control, (August 16, 1994): p. 12.

[2] Substitute House Bill No. 52450: Public Act No. 94-83, An Act Implementing the Recommendations of the Telecommunications Task Force. Hartford, CT: July 1, 1994. 33pp.

[3] SNET Telecommunications Incentive Grant: 1994-1995. New Haven, CT: Southern New England Telephone Company, February, 1994.

[4] Helen Machado, :Next Best Thing to Being There," The Hartford Courant, 156, (80), (March 21, 1994): A1, A4.

since expanded to nine courses being offered to 120 students in five school districts.[5] A SNET supplied fiber-optic link allows two-way audio and visual communication among the two of the high schools. The remote paradigm further allows districts whose numbers are increasing to offer highly specialized courses, such as Etymology, while districts with decreasing numbers are able to consolidate certain curricular areas. Recent specialized course offerings have included such highly specialized offerings as Astronomy and the Theory of Knowledge.[6] The extant schedule of course offerings is determined by the Consortium's Advisory Committee with input from the Steering Committee. With the operationalization of interactive video systems, additional projected applications include teacher training, informational programs for municipalities, and adult education.

I-SNET Electronic Information Highway

SNET's ambitious electronic information network, I-SNET, is being touted as Connecticut's version of the National Information Infrastructure. The network will be constructed over 15 years, and has a targeted completion date of 2009.[7] SNET's existing 2,400 mile long fiber optic network network will be the I-SNET backbone, with digital terminals in central offices connected to fiber optic nodes located in neighborhoods of 500 or more homes and businesses. Coaxial cables will link fiber nodes to network interface units attached either to telephone poles or to individual houses. The projected cost for the highway is estimated at approximately $4.5 billion, and since these costs are included in the Company's rate base, they can be reflected and recovered through the Company's rate schedule.

I-SNET will facilitate not only a greater and more complex mixture of entertainment options such as movies and video games, but also such business applications as video teleconferencing, electronic mailings, reports, and photographic images using fast packet switching technology. I-SNET will result in wider bandwidth, high speed, high resolution communications, and virtually unlimited range. Various institutions, such as governments, hospitals, and schools will be able, via I-SNET, to interconnect with Local Area Networks (LANS) to access the multimedia applications.[8] The net result of I-SNET will in effect be a high-speed multimedia bridge between suppliers and consumers.

Asynchronous Transfer Mode (ATM) is a fast packet switching technology to be used in the I-SNET infrastructure. ATM combines voice video, and data then transports the information using standard interfacing and switching protocols.[9] One of the ATM drivers is multimedia application, and one of those uses is distance education.

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[5] ACES: Distance Learning Consortium Manual. New Haven: Area Cooperative Educational Services, 5pp.

[6] Ibid, p. 4.

[7] Connecticut I-SNET: Introducing Connecticut's information Superhighway. New Haven: Southern New England Telephone Company, March, 1994.

[8] Dusyant Sukhija, "How ATM Will Develop in 4 Market Segments," Communications News, 31, (September, 1994):p. 23.

[9] Alan Stewart, "Bringing ATM Closer to Reality," Communications News, 31, (9), (September, 1994): pp. 16, 21.

I-SNET will speed the evolving paradigm shift in the manner in which people learn, which in turn, will have a substantive impact on the way schools transport their product. I-SNET will transform Connecticut's educational milieu into the "virtual classroom." Made possible by interactive fiber optic links, such a classroom allows teachers and students of all ages and backgrounds to interact as if they existed in the same actual classroom. Education in the Information Age is changing in the way content matter is disseminated and subsequently assimilated by students from a teacher speaking to a group of students to a teacher speaking to distant student groups through interactive fiber optic networks supporting voice and video communications in turn allowing document delivery, high-speed graphic calculations, and sophisticated medical imaging techniques.[10]

Classroom Reconfigurations

Cable operators in Connecticut together with SNET are essentially reconfiguring the state's classrooms for the Information Age. Hartford's Bulkeley High School, for example, was recently linked to suburban Hall High, in the affluent suburb of West Hartford to allow audio and visual communications.[11] The Hall-Bulkeley collaboration is but one of 11 cooperative intrastate efforts to use interactive communications technology for curricular enhancement.

Continental Cablevision, located in the upscale, north-central suburb of Enfield, has had interactive remote education up and running for about five years.[12] The fully interactive system interconnects four school districts so that advanced and specialized courses can be taught from one host district to any of the three receiving locations. Continental's system uses two channels enabling subscribers to watch both teacher and students. The system is also connected to the national education program Cable in the Classroom. Cox Cable, headquartered in the east-central town of Manchester, installed return lines several years ago as a franchise renewal requirement to allow the offering of advanced foreign language classes to high schools in the neighboring towns of Glastonbury and South Windsor. The Cox paradigm allows the offering of specialized and technical courses as Chinese and Russian. The protocol also allows a more general art history class to be taught remotely.

Legislation and Distance Learning

One particularly appealing aspect of the new interactive distance learning technology lies in its ability to afford the more rural systems to take courses that would otherwise be unavailable, such as advanced foreign languages and statistics.[13] Interactive remote education is pricey-the costs for high schools may range between

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[10] "Campus Network Graduates to Fiber Optics," Communications News, 31, (9), (September, 1994), p. 58.

[11] Helen Machado, "Next Best Thing to Being There," The Hartford Courant, 156, (80), (March 21, 1994): A1, A5.

[12] Cable Television in the Information Age. National Cable Television Association: Washington, D. C., 1992.

[13] Micheal Winerip, "Classrooms on the Information Highway," The New York Times, 143, (49,763), (June 20, 1994): B7.

$110,000 and $150,000 to purchase equipment such as modulators and demodulators, and to connect the fiber optic lines that supply the interactive capability. Schools may also spend another $40,000-50,000 in yearly access fees to local exchange companies in addition to hiring additional staff to maintain the system. The new technology works well for subjects such as foreign languages, but not quite as well for composition courses, due to theinhrent nature of the content material.

In Connecticut, a legislative proposal that would have promoted economic development and education via the emerging information highway died when it was not acted upon during the 1993 winter session. The legislation, which is expected to be revived during the winter, 1995, legislative session, seeks to establish a committee on shared information technology and an educational grant program dedicated to funding projects tied to Connecticut's electronic superhighway.[14] Connecticut has extant regulations pertaining specifically to remote education that provide a general framework for quality standards on instructional and educational channels generally shown as part of local origination programming. These regulations state:

> The provision of educational and instructional channels with a bi-directional full-motion video and the availability of educational channels via return lines for the entire franchise community....and the availability of interconnection across franchise boundaries.[15]

These regulations were promulgated in order to bring the Department's regulations into compliance with Public Act 92-146. That legislation required the Department to rule on the extent to which a cable franchise operator's distribution plant should be used to effectuate interactive remote educational protocols.[16] That legislation charged the DPUC with establishing:

> ....Quality standards for the provisioning of instructional and educational programming, including credit and no credit instructional programs for the general public.16

Emerging Educational Protocols

Knowledge Plus is a $1.3 million, 1-year, distance learning pilot program and educational information highway proposal that was recently approved by the state legislature. If approved, this interactive video network would link 14 New Haven area towns to an interactive video network to be shared among 15 school districts.[17] Every participating municipality, school, and job training center would have the ability to connect to national networks, such as the Internet, as well as access to the Internet from individual personal computers. Coaxial cable and 56kb, T1, lines will most likely

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[14] Raised Bill No. 340, An Act Connecting Connecticut to the Electronic Superhighway. Hartford, CT: March 3, 1994. (Bill died, 3/22/94)

[15] "Quality Standards for Instructional and Educational Channels," Regulations of Connecticut State Agencies, Section 16-333-42(b). New Britain, CT: Department of Public Utility Control, April, 27, 1993.

[16] An Act Concerning Educational Programming. Hartford, CT: May 27, 1992.

[17] Karla Schuster, Internet Hookup May Link Towns," The New Haven Register , 229, (August 17, 1994): B1, B3.

would allow the connections from the school districts and towns to the Internet, but no technical specifications can be delineated until funding is approved in December, 1994. The proposal was developed by the South Central Regional Council of Governments and was recently approved by the State Department of Economic Development and the State Department of Education. The final step in the process is action by the State Bond Commission for the financing of the project. The *Knowledge Plus* protocol will not use the existing ACES fiber optic backbone, but will offer educational transmission capability through school districts' existing Local Area Networks. Funding would be available for districts to construct such networks if they do not already exist.

SNET is currently conducting video-on-demand trial in the central Connecticut town of West Hartford. It is not a technology trial per se, and the methodology is crude, making use of 115 mechanically loaded VCRs to supply the programming.[18] SNET is currently awaiting FCC approval to expand its trial throughout the state, and ultimately, the technology could be upgraded to encompass various educational applications. Particularly in Connecticut, video-on-demand's educational potential is strong with about 77% of the state's homes being cable-connected as compared with approximately 60% nationally, this being, by some estimates, the highest cable penetration level in the country.[19] The sine qua non of an eventual statewide interactive information highway may well be the state's high level of cable television and telephone penetration, the latter which presently stands at 97.5%, slightly above the national average of 95.6%.[20] The video-on-demand trial expansion is being contested by cable franchise operators as an unfair form of competition for the cable business.

Legislative Enhancements

The incipient National Information Infrastructure calls for the removal of extant cable/telephone cross ownership restrictions as well as allowing telcos to offer video services in local exchange company areas.[21] The sine qua non of this issue revolves around the extent to which a regulated monopoly such as a telephone company and a virtual monopoly like a cable company can be allowed to compete for the same customer while keeping subscriber rates artificially low, much the way the intrastate toll rates have traditionally subsidized local exchange rates. With competition slowly coming to the local exchange, the distinction between cable and telephony will continue to blur. Cable operators contend that they are tethered by FCC-imposed rate freezes and various new regulations. Add into this equation the public demand for the creation of institutional networks and other education-based paradigms, and the result could be an increased rate base due to more above-the-line expenditures such as the plant a cable operator may construct for the distance learning networks. The result could be

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[18] "High Tech Video on Demand is on its Way," The New Britain Herald, 191, (August 15, 1994), p. 20.

[19] Bill Keveney, "The Cable Frontier," The Hartford Courant, 156, (171), (June 20, 1994): B1, B3.

[20] FCC Monitoring Report. Washington, D. C. Federal Communications Commission, CC Docket No. 87-339, May, 1994. p. 23.

[21] Fred Rogers, "Will the Information Superhighway be a Toll Road?" Communications Technology, (April, 1994), pp, 60-63.

some form of rate increase to subscribers so the operator can recover its construction costs, in the traditional social contract sense; i. e, all subscribers, whether premium or basic, paying for the betterment of everyone else's overall quality of programming.

Further clouding the instructional programming picture is whether a statewide inter-cable franchise institutional network with fiber-optic links to SNET's 2 million access lines may undermine the federal government's intention that instructional channels should be dedicated for only local origination or for local access purposes.[22] Connecticut's businesses are contributing more and more to the establishment of remote educational networks, a recent example being the contribution of $12,300 from the General Electric Corporation to the Plainville Middle School in central Connecticut. The school subsequently purchased a satellite dish to receive signals and link the facility to the University of Connecticut.[23] This protocol is currently functioning with an interactive link from the local cable company. The satellite feed is 1-way only for reception. A mid-term franchise review will make that link two-ways to facilitate transmission as well as reception.

The state's 24 cable franchise operators, of which about 14 presently have some type of functioning remote education program, serve over 1,000,000 subscribers. SNET is also responding to the increasing need for remote education, despite the state's small geographical size.[24] A recent DPUC ruling stated that Comcast, a cable operator serving communities along the Connecticut river:

{Comcast} shall indicate....how it intends to work with educators....to support and commence the incorporation of distance learning and other educational community cable-related needs.[25]

Some communications experts have contended that Connecticut is on fast path to the information superhighway, I-SNET and the West Hartford video-on-demand trial both being prime examples. The DPUC has implemented a series of regulatory proceedings covering issues as diverse as universal service, low-income assistance programs, and coin telephones. The state's Office of Consumer Counsel recently stated:

Theoretically, it (increased competition) should be good for the consumer if there is more competition and more choices....But nobody can tell you that for sure now. It is a very complex issue. It depends on how the implementation of the new legislation all shakes out.[26]

The recent defeat of the bill to open competition between telephone and cable companies indicates that there will be no immediate, substantive overhaul of the

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[22] DPUC Feasibility Study of Bi-Directional Transmission of Educational and Instructional Programming: Comments of Nutmeg Public Access Television, Inc. New Britain, CT: Dept. of Public Utility Control, Docket No. 93-07-09, September 30, 1993. p. 7.

[23] "Learning Center Planned with G. E. Grant," New Britain Herald, September 15, 1992, p. 13.

[24] Department of Public Utility Control:Briefing Book. New Britain, CT: DPUC, December 6, 1994, p. 7.

[25] Connecticut Department of Public Utility Control, Comcast Cablevision of Middletown, Inc., Franchise Renewal Proceeding. (Decision) Docket No. 89-06-03, May 15, 1991, p. 5.

[26] Eve Nagler, "Mapping the Telephone's New Uses" The New York Times, 144, (49,830, (September 25, 1994): 13: 1, 7.

nation's 60 year old communications law.[27] The upshot of that decision could be that technology-driven changes, such as the incipient video-on-demand assays will proceed, but that innovations will progress more slowly and in more of a piecemeal fashion. Since the bill's demise means that local exchange carriers such as SNET still cannot acquire cable companies in their own local markets, the extant video-on-demand trials are nonetheless a harbinger of the eventual demise of that regulatory prohibition. The current battle for dominance in the information highway war in the central part of the state seems to be between SNET and TCI, the nation's largest multiple systems cable franchise operator.[28] Both companies are currently introducing video-on-demand services, which have ostensibly marked the beginning of digital television programming in Connecticut and also the start of cable-telco competition.

The language of the legislation that has paved the legal path for beginning competition in the local exchange also addresses educational and instructional programming. It states:

> The two-way transmission of educational or instructional programming to a public or private elementary or secondary school, or a public or independent institution of higher learning, as required by the Department pursuant to a community antenna television company franchise agreement.[29]

Connecticut is preparing for the interactive video revolution both technologically and financially. SNET's TIG program has supplied over $40,000 to plan and to implement instructional telecommunications paradigms.[30] Besides SNET, Woodbury Telephone, a small local exchange carrier serving a few rural communities, also offers TIG funding for the school districts it serves. Funding is restricted to communications projects via the extant telephone networks. All the state's public, vocational, technical, and regional educational service centers are eligible to apply for the funding.

Remote Education and Jobs

The United States and other leading industrialized nations recently agreed that the best way to create skilled jobs is to upgrade education, particularly for the unskilled, is to supply the educational base to re-tool people for the more highly skilled technical positions.[31] This is critical in Connecticut, where national defense cutbacks in nuclear submarine construction have crippled the economies of the state's southeastern

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[27] Edmund L. Andrews, "Bill to Revamp Communications Dies in Congress," The New York Times, 144, (49,829), (September 24, 1994): pp. 1, 43.

[28] Kathleen Gorman, "Great Cable War to Beam Down on West Hartford,", The Hartford Courant, 146, (96), April 6, 1994): C1, C11.

[29] An Act Implementing the Recommendations of the Telecommunications Task Force. Hartford, CT: Public Act No. 94-83, July 1, 1994, 33 pp.

[30] SNET Telecommunications Incentive Grant, 1994-1995. New Haven: Southern New England Telephone Company, February, 1994.

[31] Thomas L. Fredman, "Accent on Education as Talks on Jobs End," The New York Times, 143, (49,637), (March 16, 1994): D1, D2.

shoreline towns such as New London, Groton, and Mystic, as the Cold War ended and demand has been greatly truncated. Additionally, new technology, ranging from robotics to the information highway is creating an ever widening gap between skilled and unskilled workers, with more of the unskilled being unemployed due to low educational levels and the inability, due to lack of technical training, to re-tool. The problem is to balance higher education, advancing technology, and improved productivity with low unemployment. Norbert Blum, Germany's Minister of Labor and Social Affairs recently stated:

> I think it is a false belief that well-trained and qualified people are not endangered by unemployment....We should be ready to retrain at any time. Retraining is the duty of management.[32]

Continental Cablevision, Inc., the nation's third largest multiple system operator behind TCI and Time-Warner, has recently begun offering a high-speed link to the Internet through the same coaxial cables that carry television channels into the home.[33] Continental's Connecticut affiliate, Continental Cable of Enfield has had an institutional network functioning since 1987.[34] Continental remote educational system is fully interactive, real-time, two-way video. The protocol allows that if sufficient interest exists for an advanced course, a teacher in one school district may teach the course to students in another district. The paradigm uses two channels so that subscribers may watch either the students, the teacher, or both. Students interact with their peers and with teachers simultaneously. This model has allowed the offering of technical courses that otherwise would have been unavailable.

Urban-Rural Learning

Connecticut's evolving information infrastructure is enabling the state to narrow the gap between its rural northeastern section and its crowded north-central corridor. Pomfret, a town of about 3,000 in the northeastern quadrant, recently began an interactive video link with Bridgeport, an inner city of about 135,000. Primarily white Pomfret students are beamed from the University of Connecticut's main campus in Storrs while the predominately black Bridgeport students are broadcast from the university's Stamford campus. The two groups, comprised from entirely different social backgrounds, are able to interact and discuss topical issues.[35] Pomfret School Superintendent Tim James stated about the program: "Awareness is probably the biggest thing. It's the one thing we thought we could really deal with."

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[32] Ibid, D2.

[33] Peter H. Lewis, "Big Cable Company to Offer a High-Speed Internet Link," The New York Times, 143, (49,630), (March 9, 1994): D1, D2.

[34] Twenty-First Century Television: Cable Television in the Information Age. National Cable Television Association, Washington, D. C.: 1994.

[35] Susan Campbell, "Video Hookup Helps Kids Reach Out Across Miles," The Hartford Courant, 156, (318), (November 14, 1994): E1, E2.

The urban-rural gap is exacerbated in many small Connecticut towns such as the Connecticut river town of Ivoryton, where information highway on-ramps to CompuServe, America Online, and to Prodigy simply do not exist except through a toll call. Rural residents are denied equal access to such on-line services because the networks, though well-developed in metropolitan areas are not available in the more rural districts due to a dearth of customers and higher installation costs for the necessary distribution plant. Further compounding the problem in small shoreline communities such as Old Saybrook and Essex are small local calling areas. Hartford residents, in contrast, can reach three dozen surrounding communities with one toll-free call, while Old Saybrook residents can reach only four.[36] It remains to be seen how this problem will ultimately be alleviated. Elsewhere, Berlin, a rural community, has used a $3,300 SNET/TIG grant to connect all five public schools in the system.[37] The town was one of 20 Connecticut schools receiving TIG money for some type of remote education communications project in 1994.

SNET recently sponsored a two-day electronic symposium on April 27-28 that allowed five Connecticut high schools to discuss the movie *Schindler's List*. Students participated interactively from their respective classrooms in North Haven, New Haven, Hamden, Cheshire, and Woodbridge, all located in the south-central part of the state. The discussions were carried over fiber-optic cable and used advanced digital technology that supplied the broadband capacity that such interactive video paradigms require.[38] Connecticut's demographics make it receptive to transmit the expanded voice, video, and data services that the I-SNET architecture will ultimately offer to the state.[39]

Multimedia Teleconferencing

In Connecticut as elsewhere, multimedia teleconferencing figures to be the killer application of the Information Age.[40] Today's prevailing distance learning paradigm gives the teacher all the bandwidth. Students generally get a voice-only return path through a telephone line. One way to enable schools to tap into multimedia teleconferencing is through the use of such software as *Virtual Meeting*. This paradigm allows users to share files and conference in real time via remote sites using LANS, telephone lines, or any other communication pathways. Further sweetening the remote education pot in Connecticut is the recent decision by the Department to allow an alternative cable franchise operator to construct a cable network where there is already

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[36] John M. Moran, "Millions in Small Towns Left Off-Line by Computer Networks," The Hartford Courant, 154, (339), A1, A7.

[37] Sandra James, "Berlin Schools Prepare to Make A Connection," The Hartford Courant, 156, (287), (October 14, 1994): B1.

[38] "SNET Sponsors High-Tech Discussion for Students." (News Release) New Haven, CT: Southern New England Telephone Company (April 26, 1994)

[39] Susan E. Kinsman, "SNET Makes Bet on its Future," The Hartford Courant, 156, (217), (October 24, 1994): B1, 12-13.

[40] David Thornburg, "Why Wait for Bandwidth?" Electronic Learning, 14, (3), (November-December, 1994): pp. 20-23.

an operator. FiberVision, the entity given permission last April by the DPUC to construct a network in a TCI affiliate's franchise territory, has committed to link all public school and town libraries in its franchise area, as well as the technical link to allow the programming, but of course, not the programming itself. Joseph McGee, outgoing Connecticut Economic Development Commissioner, recently stated:

{I-SNET} remains a big maybe. Maybe customers want it, and maybe they're willing to pay for it. But it's possible that they're not.[41]

The small, rural community of Plymouth recently approved a plan to combine resources with other districts with the greater Waterbury region to improve educational quality and cultural diversity. Among other things, the Plymouth plan includes linking its schools via a single interschool computer network to effectuate the use of distance learning.[42] What the network builders are envisioning in Connecticut as elsewhere are the prominent computer applications: video-on-demand, home shopping, interactive games, and direct response advertising. But there are also the society-transforming social contract applications such as telemedicine, distance learning, and telecommuting. The vision of the "fully wired society" is predicted to become a dynamic force for social good and result in enhancing education, medical care, and the improvement of communications. However, distance learning and information-on-demand probably will not be available for mass public consumption until interactive television takes off, and that remains several years down the road.[43] New technologies such as digital signal compression and ATM will make interactive protocols such as remote education both cost effective and widely available. Left to their own devices, cable franchise operators would probably "creamskim," that is, serve the richest neighborhoods of the most densely populated regions, such as the "Gold Coast" of Fairfield County. The Federal Government has managed to connect schools, public libraries, and hospitals to the interactive technologies, but has not yet figured out how to link up everyone else.[44]

A recent study of Connecticut's college enrollment by the State Department of Higher Education found that fewer than 50,000 of the 16,367 students enrolled at public and private colleges are 17-21 year olds attending college full-time. Only about 14.5% of the undergraduate population at the state's main university campus in Storrs is under 25 years old, and only about 4.6% of undergraduates at the state's private schools that recruit nationally-Wesleyan, Yale, Connecticut College and Trinity are under that age. The problem is that in Connecticut as in other states, higher education is structured to serve the traditional rather than the older, working, non-traditional college student.[45]

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[41] Jim Motovalli, "Cable Wars," Connecticut Magazine, 57, (4), April, 1994): pp. 37-41.

[42] Matthew Brown, "School Diversity Plan Approved," The Hartford Courant, 156, (300), (October 28, 1994):B6.

[43] Charles Piller, "Dreamnet," MacWorld, (October, 1994): pp. 2-11.

[44] Philip Elmer-DeWitt, "Play...Fast Forward...Rewind...Pause" Time, 143 (21), (May 23, 1994): 44-46.

[45] Katherine Farrish, "Young, Full-Time College Students in Minority" The Hartford Courant, 156, (75), (March 16, 1994): D1, D11.

Strategies such as networking throughout the elementary grades expand the opportunities for distance learning and for instructional television programming. Two standard, 6MHz channels, one for upstream and one for downstream transmission will allow the interactivity and thus facilitate the functioning of the remote education protocol.[46]

There is no question that education is enhanced through the use of advanced technology and interactive learning. Quite simply, interactivity links allow resources at one educational site to be used at another.[47] Technologies such as ATM can facilitate the interconnection of thousands of educational sites with interactive distance learning programs, database access, teacher training, telemedicine, prisoner education, town meetings, video conferencing, etc. Connecticut has erected the regulatory and legislative framework for the provisioning of a statewide interconnected educational network with the coming of I-SNET, and the gradual tying together of the 24 cable franchise operators' individual institutional and governmental networks.[48] Up-front technology-based grants may partially offset capital intensive networking costs, and with remote educational projects such as *Knowledge Plus* about to be funded and implemented, school districts, libraries, and higher educational institutions across the state will have electronic learning capability virtually at their doorsteps.

Lastly, as pilot program for Connecticut's south-central regional districts, *Knowledge Plus* will serve as a testing ground for research and development of remote education that can used statewide to bring advanced learning technology not only to schools, but to libraries, colleges, universities, and to the communities to raise the levels of learning and the standard of life in Connecticut. The deliverables will include internetworking, including Internet access of public schools, and the linking of schools, towns nd libraries in the south-central region as well as throughout the state. Connecticut stands poised and ready to meet the Information Age and its concomitant technological onslaught.[49]

Conclusions

The DPUC believes that it is the responsibility of the regulated entity, be it a cable operator, or a local exchange company, to address the instructional and educational needs within its franchise through the provisioning of facilities and equipment necessary for technologically advanced educational programming, where

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[46] Michael Angelo, "Implementation of Data and Communications Services," Communications Technology, (December, 1994): pp. 58-62.

[47] Patrick E. Lanthier, National Information Infrastructure Public Policy White Paper: Route 94:Information Superhighway Public Policy Road Map. Paper presented at the Rutgers Center for Research in Regulated Industries, 13th Annual Conference, Newport, RI, May 25-27, 1994. 11pp.

[48] Regional Forum No. 3 for Quality and Diversity in Education. Hartford, CT: Public Act 93-263: September, 1994, p. 9.

[49] Knowledge Plus Project Proposal. Area Cooperative Educational Services, New Haven, CT: December 6, 1994.

such needs have been identified as an integral and substantive part of the overall community needs. The educational needs must be viewed on an equal footing along with the mandated governmental and public access channels and now with instructional and educational programming. The question of cost allocations for the necessary equipment and distribution plant for educational production and origination, including classroom equipment, personnel, and in-kind support services is a complicated issue, but remains largely the responsibility of the local educators, and the funding commitments for these expenses are most properly addressed by the germane educational agency. It is for the Department to balance the magnitude of support to be supplied, and to oversee the appropriate determination of cost allocations between the company and the educational entities.

A recent survey of Connecticut public school principals indicated that even now there are copious problems in accessing information. For example, very few school computers are actually linked to information networks, existing wiring in Connecticut's public schools cannot accommodate high-speed, broadband information transfer, and about one-fourth or fewer of Connecticut public school teachers have been inadequately trained in the use of advanced technology for instructional and classroom management purposes.[50] Additionally, many school boards have not yet adopted a comprehensive plan for implementing technology in their schools. State and local officials, including school board members, political leaders, and legislators will continue to have the primary responsibility of supplying proper financial and governing leadership for schools. Remote education is poised to radically transform not only education, but healthcare, medical science, scientific, educational, military, and industrial sectors of the society. Educators and elected officials will be responsible for effectuating educational reforms through the evolving technologies.

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[50] Janet M. Grenzke, Our Children's' Schools: Are They Good Enough? A Report on the Survey of Connecticut Public School Principals. Hartford, CT: Abacus Associates, April 26, 1993. pp. 1-5.

TABLE A

Distance Learning Classroom Equipment

12	27" color video monitors	@ 700	$ 8,400
6	monitor brackets	@ 200	1,200
6	3" yoke pipes	@ 24	144
1	T42E cart with 5" casters		150
2	VTR20E 32" cart	@ 100	200
2	Winsted mini-frame	@ 144	288
6	flat monitor shelf	@ 83	498
2	frame extensions	@ 122	244
3	Panasonic D5000 video camera	@1,500	4,500
2	Panasonic WV CR12 controller	@ 345	690
1	Panasonic 10H-50AS 50' camera signal cable		115
2	Panasonic 10H-30AS 30' camera signal cable		114
2	Panasonic WV CA10 cable	@ 29	58
3	Panasonic WV 3203 power supply	@ 100	300
1	VCLO.5 for WVLZ14 8AF lens	@ 150	150
1	tripod with dolly		305
2	ceiling camera mount	@ 80	160
1	Panasonic active switcher WJ 220B		250
1	1/2" VHS VCR		350
1	Shure M67 microphone mixer		387
1	Crown sound grabber PZM microphone	@ 88	528
1	Shure SM 11CN microphone		90
	Miscellaneous cable, connectors, power & surge strips		600
TOTAL: (This figure varies according to vendor.)			$15,685 - $19,551

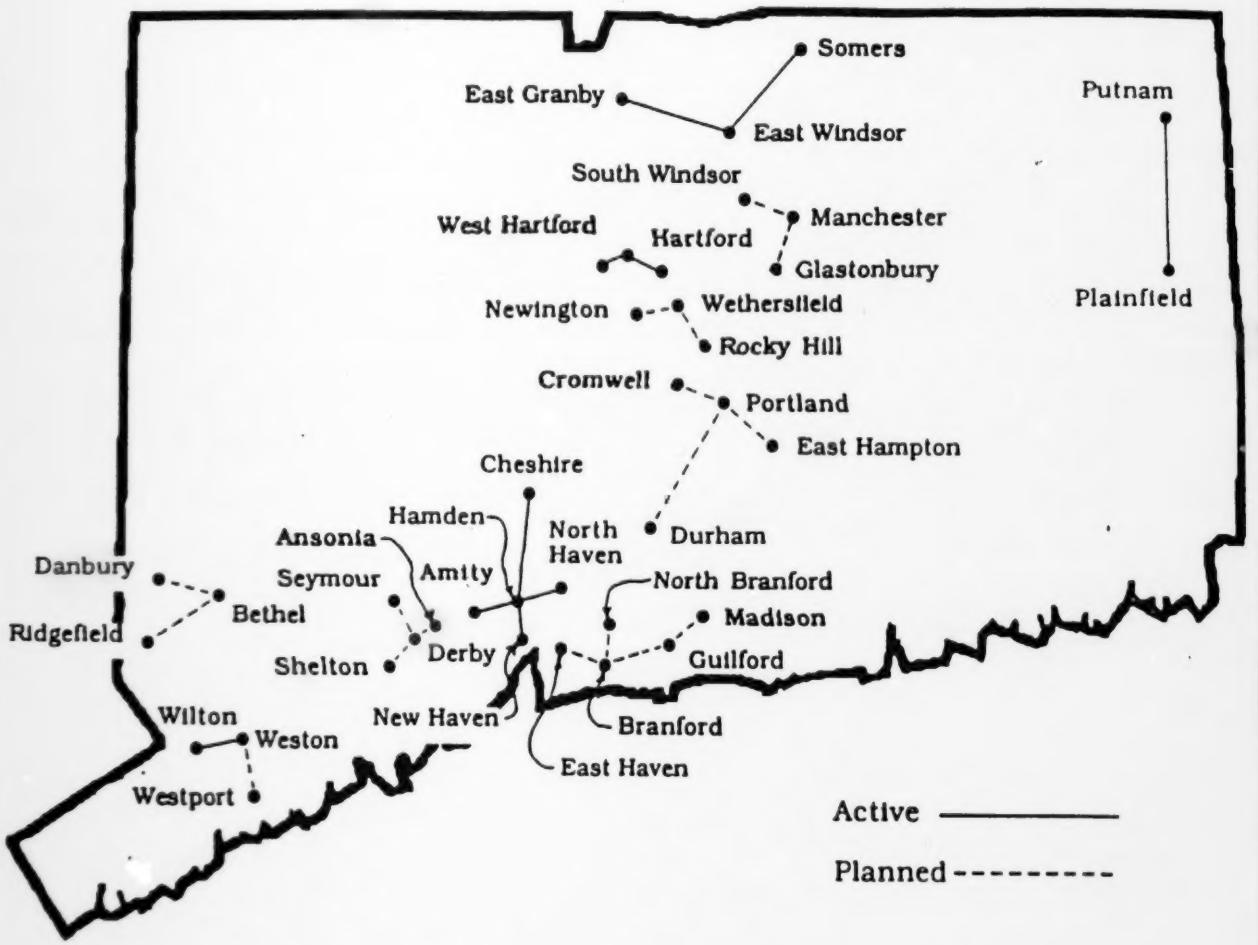
Additional equipment requirements include outside telephone line and telephone into the distance learning classroom, computers specific to offered course, printer, and modem (depending on offered course).

Equipment can be purchased over a period of time

Year 1	Minimum receiving site	$5,375
Year 2	Full receiving site	$4,425
Year 3	Minimum origination site	$4,890
Year 4	Full origination site	$ 995

Source: Valley Shore Telecommunications Cooperative, 1991.

TABLE B



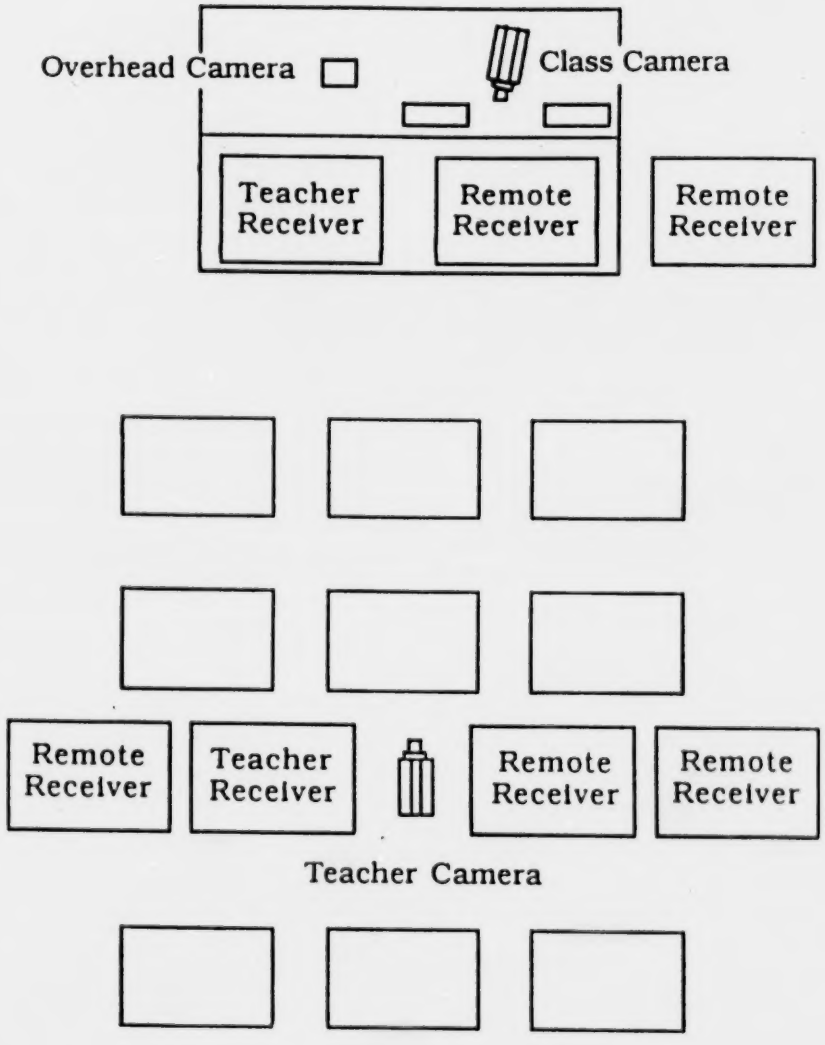
Distance Learning Projects in Connecticut

WBM 6/89
11-37

Source: Middlesex Distance Learning Consortium

TABLE C

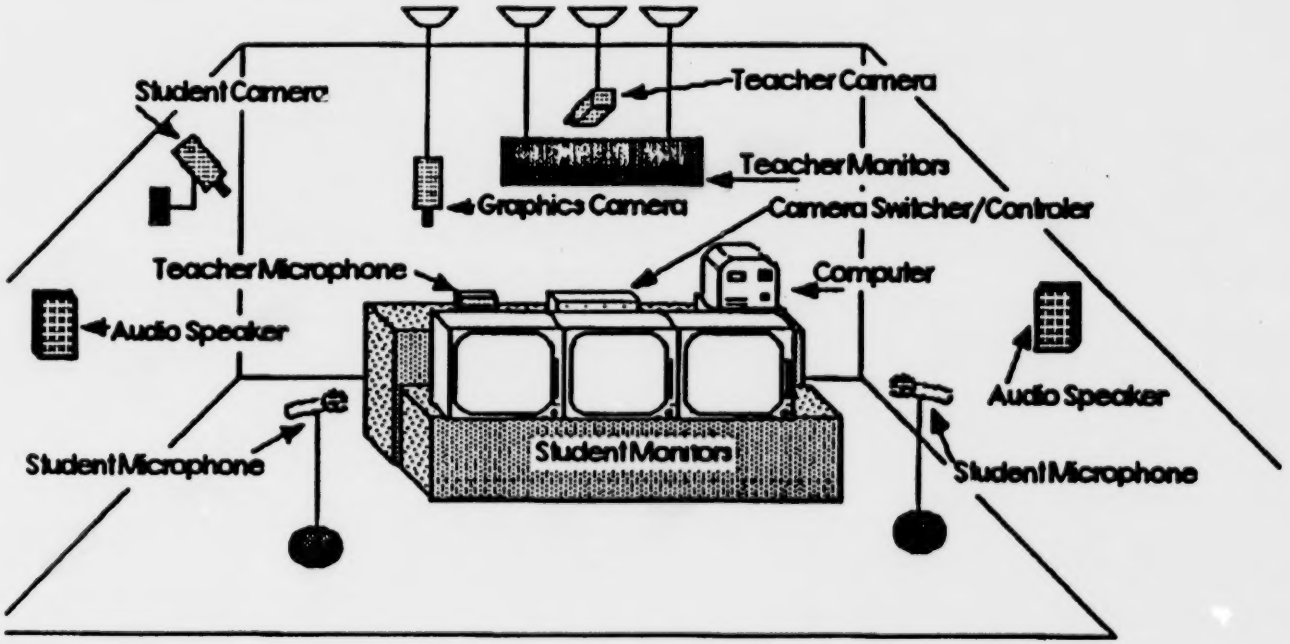
Distance Learning Classroom



WBM

Source: Middlesex Distance Learning Consortium

SNET Video Link



Distance Learning Classroom

SDE - SNET